* NOTICES *



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CLAIMS

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[Claim(s)]
[Claim 1] The wafer supporting structure which comes to lay underground the mixture of W, Mo, WC, TiC, and TiN which becomes 90 - 99 % of the weight from 1 - 10 % of the weight about AlN in a kind at least as an exoergic resistor into the base which consists of the nature sintered compact of alumimium nitride.
[Claim 2] The wafer supporting structure which comes to lay underground the mixture of W, Mo, WC, TiC, and TiN which becomes 50 - 99 % of the weight from 1 - 50 % of the weight about AlN in a kind at least as an electrode for electrostatic adsorption into the base which consists of the nature sintered compact of alumimium nitride.
[Claim 3] The wafer supporting structure which comes to lay underground the mixture of W, Mo, WC, TiC, and TiN which becomes 80 - 99 % of the weight from 1 - 20 % of the weight about AlN in a kind at least as an electrode for plasma generating into the base which consists of the nature sintered compact of alumimium nitride.

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[Translation done.]

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the wafer supporting structure used in order to contact and hold wafers, such as a semi-conductor wafer and a glass substrate for liquid crystal, in production processes, such as a semiconductor device and liquid crystal, such as a susceptor and an electrostatic chuck.
[0002]
[Description of the Prior Art] In the semi-conductor production process, in the CVD system for forming a thin film in a semi-conductor wafer, the dry etching system for performing micro processing to the above-mentioned wafer, etc., in order to hold a wafer to the processing interior of a room, the wafer supporting structure, such as a susceptor and an electrostatic chuck, is used.
[0003] A susceptor lays a wafer on the base which carried out disc-like, presses it down in a clamp ring, is supported, and can also lay the exoergic resistor for heating a wafer under the interior of a base. Moreover, an electrostatic chuck lays one or more electrodes under the interior of a base, by impressing an electrical potential difference to this electrode, produces electrostatic adsorption power and carries out adsorption immobilization of the wafer on a front face. Furthermore, in these susceptors and electrostatic chucks, there is also a thing of structure which laid the electrode for plasma generating under the interior of a base.
[0004] In addition, these wafer supporting structure is used not only for a semi-conductor wafer but for maintenance of the glass substrate for liquid crystal etc.
[0005] Although ceramics, such as an alumina, is used as the quality of the material of the base which accomplishes the above-mentioned susceptor and an electrostatic chuck, the corrosion resistance to the halogen system plasma being high, and using the nature ceramics of alumimium nitride with high thermal conductivity in recent years is proposed (reference, such as JP,6-151332,A). In this case, it is common for a tungsten (W) or molybdenum (Mo) to be used, to print these metal pastes by the predetermined pattern on the green sheet of alumimium nitride as electric conduction material which accomplishes the exoergic resistor and the electrode for electrostatic adsorption which are laid under the interior of a base, and the electrode for plasma generating, to carry out the laminating of this, and to really calcinate.
[0006]

[Problem(s) to be Solved by the Invention] However, it set to the production process of the wafer supporting structure which laid the electric conduction material of W or Mo underground as an exoergic resistor etc. into the base which consists of the above-mentioned nature ceramics of alumimium nitride, and at the time of baking, the crack arose in the base according to the difference of contraction of a base and an electric conduction material part, and there was a trouble of an electric conduction material part being exfoliated or disconnected. When the nature ceramics of alumimium nitride of a high grade was especially used as a base, the problem by the difference of the above-mentioned contraction was remarkable.

[0007] Moreover, when the obtained wafer supporting structure was used, since a differential thermal expansion was between 4.6 - 4.8x10-6/degree C, 5.7x10-6/degree C, and both, the coefficient of thermal expansion of W and Mo which are electric conduction material to the coefficient of thermal expansion of the alumimium nitride which accomplishes a base being 5x10-6/degree C also had the trouble of being easy to produce a crack etc. by this differential thermal expansion, respectively. For example, in order to perform the ON-OFF pulse control of the electrical potential difference beyond 100V in the susceptor which laid the exoergic resistor underground, from the difference in the above-mentioned coefficient of thermal expansion accompanying the rapid temperature up at the time of actuation, the crack arose in the interface of a base and an exoergic resistor, and the problem of an exoergic resistor being exfoliated or disconnected was in it. Therefore, such a susceptor's could not perform a rapid temperature up, but having un-arranged [ working efficiency is not only very bad, but that it must perform temperature control at the time of a temperature up ].

[0008] In addition, in the case of the electrode for electrostatic adsorption, or the electrode for plasma generating, a rapid temperature up was not performed, but since all had the large electrode, there were problems, like during long-term use, a crack arises in a base by the differential thermal expansion with a base.

[0009]

[Means for Solving the Problem] This invention is characterized by laying underground the mixture of W, Mo, WC, TiC, and TiN which becomes 90 - 99 % of the weight from 1 - 10 % of the weight about AlN in a kind at least as an exoergic resistor into the base of the nature sintered compact of alumimium nitride which accomplishes the wafer supporting structure.

[0010] namely, -- as an exoergic resistor -- the thing of W, Mo, WC, TiC, and TiN for which the mixture of a kind and AlN is used at least -- the time of rising and falling temperature and an elevated temperature -- setting -- thermodynamic -- stable -- moreover -- mixing -- AlN in the living body prevents exfoliation and crack initiation of nothing, a base, and an exoergic resistor for the work which heightens bonding strength with the nature sintered compact of alumimium nitride which is a base.

[0011] Moreover, this invention is characterized by laying underground the mixture of W, Mo, WC, TiC, and TiN which becomes 50 - 99 % of the weight from 1 - 50 % of the weight about AlN in a kind at least as an electrode for electrostatic adsorption into the base of the nature sintered compact of alumimium nitride which accomplishes the wafer supporting structure.

[0012] Furthermore, this invention is characterized by laying underground the mixture of

W, Mo, WC, TiC, and TiN which becomes 80 - 99 % of the weight from 1 - 20 % of the weight about AlN in a kind at least as an electrode for plasma generating into the base of the nature sintered compact of alumimium nitride which accomplishes the wafer supporting structure.

[0013] That is, like [ electrode / the electrode for electrostatic adsorption, or / for plasma generating ] an exoergic resistor, by [ of W Mo, WC, TiC, and TiN ] using the mixture of a kind and AlN at least, the affinity force with a base is heightened and exfoliation long-term in use and crack initiation are prevented.

[0014]

[Example] The example of this invention is explained below.

[0015] The susceptor 10 shown in drawing 1 (A) lays the exoergic resistor 12 underground into the base 11 which consists of a nature sintered compact of alumimium nitride, and is equipped with the lead wire 13 for energizing to this exoergic resistor 12 and making it generate heat. Where the semi-conductor wafer 30 is laid in the front face of this susceptor 10, it can hold to the processing interior of a room, such as a CVD system and a dry etching system, and it can energize to the exoergic resistor 13, the semi-conductor wafer 30 can be heated, and various processings can be performed.

[0016] As for the nature sintered compact of alumimium nitride which accomplishes the above-mentioned base 11, it is desirable that an AlN content uses 99% of the weight or more of the nature sintered compact of high grade alumimium nitride. That is, by making the content of AlN into 99.5 % of the weight or more and 99.8 more % of the weight or more preferably 99% of the weight or more, in the sintered compact, a grain boundary phase should hardly exist, but it should excel in corrosion resistance. And above-mentioned within the limits, then above-mentioned thermal conductivity can be made into 65 or more W/m-K for an AlN content. Moreover, in order to raise the corrosion resistance under halogen system corrosive gas, it is desirable to set preferably 1500 ppm or less of contents of Si to 1000 ppm or less, and it is desirable to set the sum total of Na, calcium, Fe, etc. to 2000 ppm or less as other impurities further. Moreover, 5-50 micrometers of average crystal particle diameter of this nature sintered compact of alumimium nitride are preferably set to 20-30 micrometers.

[0017] in addition, the nature sintered compact of alumimium nitride which accomplishes a base 10 -- not only as the thing of the above-mentioned high grade but sintering acid -- the [, such as CaO, SrO, and BaO, / periodic table ] -- 2a ****** oxide, and Y2 O3, Er 2O3 and Yb 2O3 etc. -- the [ periodic table ] -- 0.5 - 20% of the weight of the added thing which came out of comparatively may be used in 3a group element oxide. What raised thermal conductivity to 180 - 250 W/m-K can be suitably used by furthermore vaporizing these assistant components to about 0.001 - 1% of the weight in a baking process.

[0018] On the other hand, the exoergic resistor 12 forms 90 - 99 % of the weight, and AlN for a kind from 1 - 10% of the weight of a mixture, even if there are little W, Mo, WC, TiC, and TiN. Or if AlN exceeds 10 % of the weight, the electric resistance value of the exoergic resistor 12 will become large too much, and it will become unstable [ resistance ]. having limited these presentations to the above-mentioned range -- W, Mo, WC, TiC, and TiN -- at least -- a kind -- less than 90 % of the weight -- A good heat generation characteristic is not acquired and it is [ of W, Mo, WC, TiC, and TiN ] for the adhesion of the exoergic

resistor 12 and a base 11 to fall that a kind exceeds 99 % of the weight at least, or AlN is less than 1 % of the weight. Even if there are little W, Mo, WC, TiC, and TiN, 4 - 7% of the weight of the range of AlN is [ a kind ] desirably, good 93 to 96% of the weight.

[0019] Thus, by containing AlN in the exoergic resistor 12, adhesion with a base 11 can be raised and the crack of a base 11, exfoliation of the exoergic resistor 12, and an open circuit can be prevented also at the time of a rapid temperature up.

[0020] In order to manufacture the susceptor 10 of this invention, with the mean particle diameter of about 1.2 micrometers And after carrying out addition mixing only of a binder and the solvent at the AlN powder of 99% or more of purity which contains 1000 ppm or less of Si in 500 ppm or less preferably as an impurity and obtaining slurry, Two or more green sheets with a thickness of about 0.5mm are fabricated with a doctor blade method. The resistive paste which specific surface area (BET) mixed at least a kind of powder of W, Mo, WC, TiC, and TiN and AlN powder more than 2m2/g on the Green sheet of one sheet, and carried out viscosity control to it is screen-stenciled among those, and the exoergic resistor 12 is formed.

[0021] And the laminating of two or more green sheets is carried out on the above-mentioned exoergic resistor 12, and it is 50kg/cm2. The susceptor 10 which it is 99% or more of purity, and the content of Si becomes from the nature sintered compact of alumimium nitride 1000 ppm or less can be obtained by being stuck by pressure by the pressure, performing vacuum cleaning, after performing cutting after that and considering as a disc-like plate, and calcinating under a vacuum ambient atmosphere with a burning temperature of about 2000 degrees C. In addition, low attachment of the connection between the internal exoergic resistor 12 and lead wire 13 is carried out, and it should just attach the metal rod which accomplishes lead wire 13 through a metallized layer.

[0022] In addition, thickness, a printing pattern, etc. of the exoergic resistor 12 can be freely adjusted, in order to acquire predetermined resistance. Moreover, as shown in drawing 1 (B), resistance can be low adjusted by forming the exoergic resistor 12 in a multilayer.

[0023] W, Mo, WC, TiC and the TiN powder whose mean particle diameter is 1.0 micrometers as the quality of the material of the exoergic resistor 12 here, and AlN powder with a mean particle diameter of 1.2 micrometers were prepared, and addition mixing of a binder and the solvent was carried out, a part for a solvent was volatilized in the evaporator, resistive paste was adjusted, and after carrying out ball mill mixing at a rate shown in Table 1, the exoergic resistor 12 was formed so that final resistance might be set to 4-6ohm.

[0024] To the obtained susceptor 10, the electrical potential difference of 150V was impressed in ON-OFF, and the heat generation characteristic was evaluated. As the concrete evaluation approach, the rapid temperature up test which performs the temperature up from a room temperature to 600 degrees C in 10 minutes within a vacuum housing was observed for existence, such as an open circuit of the exoergic resistor 12, the existence of the crack initiation of a base 11, etc. after 100 cycle **********. A result is as being shown in Table 1.

[0025] From the result of Table 1, in less than 1% of the weight of the thing, since adhesion with a base 11 was bad, the crack arose [ the AlN content in the exoergic resistor

12 ] in the base 11 by the rapid temperature up test. On the other hand, as shown in drawing 1 (B), as for that to which the AlN content exceeded 10 % of the weight, the exoergic resistor 12 was made into the multilayer, in the number of patterns, resistance was high also as plurality and predetermined resistance was not acquired.

[0026] To these, after a rapid temperature up test has neither a crack nor an open circuit in any way, and each thing of this invention which made the amount of AlN(s) in the exoergic resistor 12 1 - 10 % of the weight within the limits was excellent in endurance.

[0027]

[Table 1]

| No | 発熱抵抗体 | | | 急速昇温試験後の状況 |
|---|---|---|---|---|
| | 組成（wt%） | 厚み（μm） | パターン数 | |
| ＊1 | W 100 AlN 0 | 12 | 1 | 亀裂発生 |
| 2 | W 99 AlN 1 | 12 | 1 | 良好 |
| 3 | W 95 AlN 5 | 14 | 1 | 良好 |
| 4 | W 90 AlN 10 | 12 | 3 | 良好 |
| ＊5 | W 87 AlN 13 | 12 | 9 | 抵抗値大 |
| ＊6 | W 84 AlN 16 | 14 | 製作不可 | |
| ＊7 | Mo 100 AlN 0 | 12 | 1 | 亀裂発生 |
| 8 | Mo 99 AlN 1 | 12 | 1 | 良好 |
| 9 | Mo 95 AlN 5 | 14 | 1 | 良好 |
| 10 | Mo 90 AlN 10 | 12 | 3 | 良好 |
| ＊11 | Mo 87 AlN 13 | 12 | 9 | 抵抗値大 |
| ＊12 | WC 100 AlN 0 | 18 | 1 | 亀裂発生 |
| 13 | WC 99 AlN 1 | 18 | 1 | 良好 |
| 14 | WC 95 AlN 5 | 22 | 1 | 良好 |
| 15 | WC 90 AlN 10 | 18 | 3 | 良好 |
| ＊16 | WC 87 AlN 13 | 18 | 9 | 抵抗値大 |
| ＊17 | TiN 100 AlN 0 | 20 | 1 | 亀裂発生 |
| 18 | TiN 99 AlN 1 | 20 | 1 | 良好 |
| 19 | TiN 95 AlN 5 | 24 | 1 | 良好 |
| 20 | TiN 90 AlN 10 | 20 | 3 | 良好 |
| ＊21 | TiN 87 AlN 13 | 20 | 9 | 抵抗値大 |

＊は本発明の範囲外である。

[0028] Next, other examples of this invention are explained.

[0029] The electrostatic chuck 20 shown in drawing 2 lays the electrode 22 for electrostatic adsorption, and the electrode 23 for plasma generating underground into the base 21 made from the nature sintered compact of alumimium nitride, and is equipped with the lead wire (un-illustrating) for energizing to each electrode.

[0030] And if an electrical potential difference 25 is impressed between the above-mentioned electrode 22 for electrostatic adsorption, and the semi-conductor wafer 30, electrostatic adsorption power arises on the front face of a base 21, and the semi-

conductor wafer 30 can be adsorbed. In addition, although the acyclic type was shown by a diagram, two or more electrodes 22 for electrostatic adsorption can be laid underground into a base 21, and it can also consider as the bipolar type it was made to impress an electrical potential difference to each inter-electrode one. Moreover, by impressing high-frequency voltage 26 between the electrode 23 for plasma generating, and the up electrode 24, the plasma is generated between two electrodes and etching, CVD processing, etc. of the semi-conductor wafer 30 can be performed.

[0031] The nature sintered compact of alumimium nitride which accomplishes the above-mentioned base 21 uses the thing of the same high grade as said example, or the thing containing sintering acid. Moreover, it is the same as that of said example also about the manufacture approach of the electrostatic chuck 20.

[0032] Furthermore, the thing of W, Mo, WC, TiC, and TiN which consists 50 - 99 % of the weight and AlN of a mixture with 1 - 50 % of the weight in a kind at least is used for the electrode 22 for electrostatic adsorption. having made the presentation ratio into the above-mentioned range here -- AlN -- less than 1 % of the weight -- or W, Mo, WC, TiC, and TiN -- if a kind exceeds 99 % of the weight at least, or adhesion with a base will worsen and AlN will, on the other hand, exceed 50 % of the weight -- or W, Mo, WC, TiC, and TiN -- resistance becomes it high that a kind is less than 50 % of the weight at least too much, and it is because it is unsuitable. Thus, since a current does not flow, in the case of the electrode 22 for electrostatic adsorption, it is possible to enlarge resistance compared with the case of the exoergic resistor of said example, and it can make [ many ] the content of AlN.

[0033] Moreover, the thing of W, Mo, WC, TiC, and TiN which consists 80 - 99 % of the weight and AlN of a mixture with 1 - 20 % of the weight in a kind at least is used for the electrode 23 for plasma generating. having made the presentation ratio into the above-mentioned range here -- AlN -- less than 1 % of the weight -- or W, Mo, WC, TiC, and TiN -- if a kind exceeds 99 % of the weight at least, or adhesion with a base will worsen and AlN will, on the other hand, exceed 20 % of the weight -- or W, Mo, WC, TiC, and TiN -- resistance becomes it high that a kind is less than 80 % of the weight at least too much, and it is because it is unsuitable. Even if there are little W, Mo, WC, TiC, and TiN preferably, 1 - 10% of the weight of the range is [ kind ] good in 90 - 99 % of the weight, and AlN.

[0034] In addition, as for the above-mentioned electrode 23 for plasma generating, it is desirable to form in the range larger than the semi-conductor wafer 30 to which it sticks. This is for generating the plasma over the whole surface of the semi-conductor wafer 30, processing the whole surface of the semi-conductor wafer 30, and taking a chip efficiently. In this case, although some bases 21 will be put to the plasma, since it has formed with a corrosion resistance high nature sintered compact of alumimium nitride which was mentioned above, there is no possibility that it may be etched by the plasma.

[0035] Since these electrodes 22 for electrostatic adsorption and the electrode 23 for plasma generating contain AlN, its adhesion with a base 21 is high, and they can prevent a possibility that a crack etc. may arise also at the time of long-term use.

[0036] Moreover, although the above-mentioned example showed the example which formed separately the electrode 22 for electrostatic adsorption, and the electrode 23 for

plasma generating, it can also serve as both with one electrode. In this case, what is necessary is just to consider as the same presentation range as the case of the electrode 23 for plasma generating.

[0037] Furthermore, although not illustrated, an exoergic resistor is laid underground into the base 21 of the electrostatic chuck 20, and it can make it possible to heat.

[0038] Although the above example described only the supporting structure of the semiconductor wafer 30, it cannot be overemphasized that this invention is applicable as the supporting structure of various wafers, such as a glass substrate for liquid crystal.

[0039]

[Effect of the Invention] Even if there are little W, Mo, WC, TiC, and TiN according to this invention, a kind in the base which consists of the nature sintered compact of alumimium nitride Thus, 90 - 99 % of the weight, By having laid underground the mixture which consists AlN of 1 - 10 % of the weight as an exoergic resistor, and having constituted the wafer supporting structure, it can prevent that make adhesion of a base and an exoergic resistor high and the crack of a base, exfoliation of an exoergic resistor, an open circuit, etc. arise also at the time of a rapid temperature up. Therefore, the wafer supporting structure of the high performance which can carry out a rapid temperature up in 10 minutes to 600 degrees C can be offered.

[0040] Even if there are little W, Mo, WC, TiC, and TiN according to this invention, a kind in the base which consists of the nature sintered compact of alumimium nitride Moreover, 50 - 95 % of the weight, By having laid underground the mixture which consists AlN of 5 - 50 % of the weight as an electrode for electrostatic adsorption, and having constituted the wafer supporting structure, adhesion of a base and the electrode for electrostatic adsorption can be made high, the crack of the base at the time of use, exfoliation of the electrode for electrostatic adsorption, etc. can be prevented, and it can be used suitably for a long period of time.

[0041] Even if there are little W, Mo, WC, TiC, and TiN according to this invention, a kind in the base which consists of the nature sintered compact of alumimium nitride Furthermore, 80 - 95 % of the weight, By having laid underground the mixture which consists AlN of 5 - 20 % of the weight as an electrode for plasma generating, and having constituted the wafer supporting structure Adhesion of a base and the electrode for plasma generating can be made high, the crack of the base at the time of use, exfoliation of the electrode for plasma generating, etc. can be prevented, and it can be used suitably for a long period of time.

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[Translation done.]

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]
[Drawing 1] (A) and (B) are the sectional views showing the susceptor which is one example of the wafer supporting structure of this invention.
[Drawing 2] It is the sectional view showing the electrostatic chuck which is one example of the wafer supporting structure of this invention.
[Description of Notations]
10: Susceptor
11: Base
12: Exoergic resistor
13: Lead wire
20: An electrostatic chuck
21: Base
22: The electrode for electrostatic adsorption
23: The electrode for plasma generating
24: Up electrode
30: Semi-conductor wafer

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[Translation done.]

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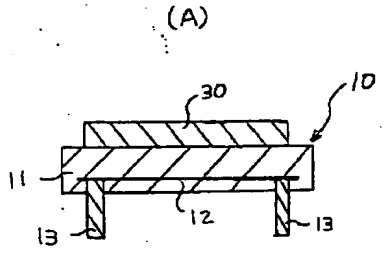
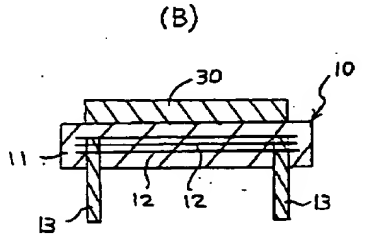
(54)【発明の名称】　ウェハ保持装置

(57)【要約】
【構成】窒化アルミニウム質焼結体から成る基体１１中に、Ｗ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種を９０～９９重量%と、ＡｌＮを１～１０重量%からなる混合体を発熱抵抗体１２として埋設してウェハ保持装置を構成する。
【効果】基体１１と発熱抵抗体１２との密着性を高くして、急速昇温時にも基体１１の亀裂や発熱抵抗体１２の剥離、断線等が生じることを防止できる。そのため、６００℃まで１０分で急速昇温することが可能である高性能のウェハ保持装置を提供できる。



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【特許請求の範囲】

【請求項１】窒化アルミニウム質焼結体から成る基体中に、Ｗ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種を９０～９９重量％と、ＡｌＮを１～１０重量％からなる混合体を発熱抵抗体として埋設してなるウェハ保持装置。

【請求項２】窒化アルミニウム質焼結体から成る基体中に、Ｗ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種を５０～９９重量％と、ＡｌＮを１～５０重量％からなる混合体を静電吸着用電極として埋設してなるウェハ保持装置。

【請求項３】窒化アルミニウム質焼結体から成る基体中に、Ｗ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種を８０～９９重量％と、ＡｌＮを１～２０重量％からなる混合体をプラズマ発生用電極として埋設してなるウェハ保持装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、半導体装置や液晶等の製造工程中に半導体ウェハや液晶用ガラス基板等のウェハを接触して保持するために使用するサセプタや静電チャック等のウェハ保持装置に関する。

【０００２】

【従来の技術】半導体製造工程において、半導体ウェハに薄膜を形成するためのＣＶＤ装置や、上記ウェハに微細加工を施すためのドライエッチング装置等においては、ウェハを処理室内に保持するために、サセプタや静電チャック等のウェハ保持装置が使用されている。

【０００３】サセプタは、円板状をした基体の上にウェハを載置してクランプリングで押さえつけて支持するようにしたものであり、ウェハを加熱するための発熱抵抗体を基体の内部に埋設することもできる。また、静電チャックは基体の内部に一つまたは複数の電極を埋設し、この電極に電圧を印加することによって静電吸着力を生じ、表面にウェハを吸着固定するものである。さらに、これらのサセプターや静電チャックにおいて、プラズマ発生用の電極を基体の内部に埋設した構造のものもある。

【０００４】なお、これらのウェハ保持装置は、半導体ウェハに限らず液晶用ガラス基板等の保持にも使用されている。

【０００５】上記サセプターや静電チャックを成す基体の材質としてはアルミナ等のセラミックスが使用されているが、近年、ハロゲン系プラズマへの耐食性が高く、熱伝導率の高い窒化アルミニウム質セラミックスを用いることが提案されている（特開平６－１５１３３２号公報等参照）。この場合、基体の内部に埋設する発熱抵抗体、静電吸着用電極、プラズマ発生用電極を成す導電材としては、タングステン（Ｗ）またはモリブデン（Ｍｏ）が用いられ、これらの金属ペーストを窒化アルミニウムのグリーンシート上に所定のパターンで印刷し、これを積層して一体焼成することが一般的である。

2

【０００６】

【発明が解決しようとする課題】ところが、上記窒化アルミニウム質セラミックスから成る基体中に、Ｗ又はＭｏの導電材を発熱抵抗体等として埋設したウェハ保持装置の製造工程において、焼成時に基体と導電材部分との収縮率の差によって、基体に亀裂が生じたり導電材部分が剥離または断線する等の問題点があった。特に、基体として高純度の窒化アルミニウム質セラミックスを用いた場合、上記収縮率の差による問題が顕著であった。

【０００７】また、得られたウェハ保持装置を使用する場合、基体を成す窒化アルミニウムの熱膨張率が５×１０$^{-6}$／℃であるのに対し、導電材であるＷ，Ｍｏの熱膨張率はそれぞれ４．６～４．８×１０$^{-6}$／℃、５．７×１０$^{-6}$／℃と両者間には熱膨張差があるため、この熱膨張差によって亀裂等が生じやすいという問題点もあった。例えば発熱抵抗体を埋設したサセプタにおいては１００Ｖ以上の電圧のＯＮ－ＯＦＦパルス制御を行うため、作動時の急速昇温に伴う上記熱膨張率の違いから、基体と発熱抵抗体との界面に亀裂が生じたり、発熱抵抗体が剥離あるいは断線する等の問題があった。そのため、このようなサセプタは急速昇温を行うことができず、作業効率が極めて悪いだけでなく、昇温時の温度制御を行わなければならないという不都合があった。

【０００８】なお、静電吸着用電極やプラズマ発生用電極の場合は急速昇温を行うことはないが、いずれも電極が大きいため基体との熱膨張差により長期使用中には基体に亀裂が生じるなどの問題があった。

【０００９】

【課題を解決するための手段】本発明は、ウェハ保持装置を成す窒化アルミニウム質焼結体の基体中に、Ｗ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種を９０～９９重量％と、ＡｌＮを１～１０重量％からなる混合体を発熱抵抗体として埋設したことを特徴とする。

【００１０】即ち、発熱抵抗体としてＷ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種とＡｌＮとの混合体を用いることによって、昇降温時や高温時において熱力学的に安定であり、しかも混合体中のＡｌＮが基体である窒化アルミニウム質焼結体との結合力を高める働きをなし、基体と発熱抵抗体との剥離や亀裂の発生を防止するようにしたものである。

【００１１】また本発明は、ウェハ保持装置を成す窒化アルミニウム質焼結体の基体中に、Ｗ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種を５０～９９重量％と、ＡｌＮを１～５０重量％からなる混合体を静電吸着用電極として埋設したことを特徴とする。

【００１２】さらに本発明は、ウェハ保持装置を成す窒化アルミニウム質焼結体の基体中に、Ｗ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種を８０～９９重量％

と、ＡｌＮを１～２０重量%からなる混合体をプラズマ発生用電極として埋設したことを特徴とする。

【００１３】即ち、静電吸着用電極やプラズマ発生用電極についても発熱抵抗体と同様にW，Ｍｏ，WC，ＴｉＣ，ＴｉNの少なくとも一種とＡｌＮとの混合体を用いることによって、基体との結合性力を高め、長期使用中の剥離や亀裂の発生を防止するようにしたものである。

【００１４】

【実施例】以下本発明の実施例を説明する。

【００１５】図１（Ａ）に示すサセプタ１０は、窒化アルミニウム質焼結体からなる基体１１中に発熱抵抗体１２を埋設し、該発熱抵抗体１２に通電し発熱させるためのリード線１３を備えたものである。このサセプタ１０の表面に半導体ウェハ３０を載置した状態でＣＶＤ装置やドライエッチング装置等の処理室内に保持し、発熱抵抗体１３に通電して半導体ウェハ３０を加熱してさまざまな加工を行うことができる。

【００１６】上記基体１１を成す窒化アルミニウム質焼結体は、ＡｌＮ含有量が９９重量%以上の高純度窒化アルミニウム質焼結体を用いることが好ましい。即ち、ＡｌＮの含有量を９９重量%以上、好ましくは９９．５重量%以上、さらには９９．８重量%以上とすることにより、焼結体中にはほとんど粒界相が存在せず耐食性に優れたものとすることができる。しかも、ＡｌＮ含有量を上記範囲内とすれば、熱伝導率を６５Ｗ／ｍ・Ｋ以上とすることができる。また、ハロゲン系腐食性ガス下での耐食性を高めるために、Ｓｉの含有量を１５００ｐｐｍ以下、好ましくは１０００ｐｐｍ以下とすることが好ましく、さらにその他の不純物としてＮａ，Ｃａ，Ｆｅ等の合計を２０００ｐｐｍ以下とすることが好ましい。また、この窒化アルミニウム質焼結体の平均結晶粒子径は５～５０μｍ、好ましくは２０～３０μｍとする。

【００１７】なお、基体１０を成す窒化アルミニウム質焼結体は、上記高純度のものに限らず、焼結助剤としてＣａＯ，ＳｒＯ，ＢａＯ等の周期律表第２ａ族元素酸化物や、$Y_2O_3$，$Er_2O_3$，$Yb_2O_3$等の周期律表第３ａ族元素酸化物を０．５～２０重量%の割合で添加したものでも良い。さらに焼成過程でこれらの助剤成分を０．００１～１重量%程度にまで揮散させることによって熱伝導率を１８０～２５０Ｗ／ｍ・Ｋまで高めたものも好適に使用できる。

【００１８】一方、発熱抵抗体１２はW，Ｍｏ，WC，ＴｉＣ，ＴｉNの少なくとも一種を９０～９９重量%とＡｌＮを１～１０重量%の混合体から形成する。これらの組成を上記範囲に限定したのは、W，Ｍｏ，WC，ＴｉＣ，ＴｉNの少なくとも一種が９０重量%未満かまたはＡｌＮが１０重量%を超えると発熱抵抗体１２の電気抵抗値が大きくなりすぎて抵抗値も不安定となり、良好な発熱特性が得られず、またW，Ｍｏ，WC，ＴｉＣ，ＴｉNの少なくとも一種が９９重量%を超えるかまたはＡｌＮが１重量%未満であると発熱抵抗体１２と基体１１の密着性が低下するためである。望ましくは、W，Ｍｏ，WC，ＴｉＣ，ＴｉNの少なくとも一種が９３～９６重量%、ＡｌＮが４～７重量%の範囲が良い。



【００１９】このように、発熱抵抗体１２中にＡｌＮを含有することによって、基体１１との密着性を高め、急速昇温時にも基体１１の亀裂や発熱抵抗体１２の剥離、断線を防止することができる。

【００２０】本発明のサセプタ１０を製造するには、平均粒子径１．２μｍ程度で、かつ不純物としてＳｉを１０００ｐｐｍ以下、好ましくは５００ｐｐｍ以下の範囲で含む純度９９%以上のＡｌＮ粉末にバインダーおよび溶媒のみを添加混合して泥漿を得たあと、ドクターブレード法にて厚さ０．５ｍｍ程度のグリーンシートを複数枚成形し、そのうち１枚のグリーンーシートに、比表面積（ＢＥＴ）が２$m^2$／ｇ以上のW，Ｍｏ，WC，ＴｉＣ，ＴｉNの少なくとも一種の粉末とＡｌＮ粉末を混合して粘度調整した抵抗体ペーストをスクリーン印刷して発熱抵抗体１２を形成する。

【００２１】そして、上記発熱抵抗体１２上に複数のグリーンシートを積層して５０ｋｇ／$cm^2$の圧力で圧着し、その後切削加工を施して円板状の板状体としたのち真空脱脂を施し、焼成温度２０００℃程度の真空雰囲気下で焼成することにより、純度９９%以上で、かつＳｉの含有量が１０００ｐｐｍ以下の窒化アルミニウム質焼結体からなるサセプタ１０を得ることができる。なお内部の発熱抵抗体１２とリード線１３との接続は、例えばメタライズ層を介してリード線１３を成す金属棒等をロウ付けして取り付ければ良い。

【００２２】なお、発熱抵抗体１２の厚みや印刷パターン等は、所定の抵抗値を得るために自由に調整することができる。また、図１（Ｂ）に示すように、発熱抵抗体１２を多層に形成することによって抵抗値を低く調整することができる。

【００２３】ここで、発熱抵抗体１２の材質として、平均粒径が１．０μｍのW，Ｍｏ，WC，ＴｉＣ，ＴｉN粉末と、平均粒径１．２μｍのＡｌＮ粉末を準備し、表１に示す割合でボールミル混合した後、バインダー及び溶媒を添加混合し、エバポレータにて溶媒分を揮発して抵抗体ペーストを調整し、最終的な抵抗値が４～６Ωとなるように発熱抵抗体１２を形成した。

【００２４】得られたサセプタ１０に対して、１５０Ｖの電圧をＯＮ－ＯＦＦにて印加し、発熱特性を評価した。具体的な評価方法としては、真空容器内にて室温から６００℃までの昇温を１０分にて行う急速昇温テストを１００サイクル繰り返した後、発熱抵抗体１２の断線等の有無や、基体１１のクラック発生の有無等を観察した。結果は表１に示す通りである。

【００２５】表１の結果より、発熱抵抗体１２中のＡｌＮ含有量が１重量%未満のものでは基体１１との密着性

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が悪いために急速昇温テストにより基体１１にクラックが生じた。一方、ＡｌＮ含有量が１０重量%を超えたものは、図１（Ｂ）に示すように発熱抵抗体１２を多層としてパターン数を複数としても抵抗値が高く、所定の抵抗値が得られなかった。

【００２６】これらに対し、発熱抵抗体１２中のＡｌＮ＊量を１～１０重量%とした本発明の範囲内のものは、いずれも急速昇温テスト後も何ら亀裂や断線などがなく、耐久性に優れたものであった。

【００２７】

【表１】

| No | 発熱抵抗体 | | | 急速昇温試験後の状況 |
|---|---|---|---|---|
| | 組成（wt%） | 厚み（μm） | パターン数 | |
| ＊1 | W 100 AlN 0 | 12 | 1 | 亀裂発生 |
| 2 | W 99 AlN 1 | 12 | 1 | 良好 |
| 3 | W 95 AlN 5 | 14 | 1 | 良好 |
| 4 | W 90 AlN 10 | 12 | 3 | 良好 |
| ＊5 | W 87 AlN 13 | 12 | 9 | 抵抗値大 |
| ＊6 | W 84 AlN 16 | 14 | 製作不可 | |
| ＊7 | Mo 100 AlN 0 | 12 | 1 | 亀裂発生 |
| 8 | Mo 99 AlN 1 | 12 | 1 | 良好 |
| 9 | Mo 95 AlN 5 | 14 | 1 | 良好 |
| 10 | Mo 90 AlN 10 | 12 | 3 | 良好 |
| ＊11 | Mo 87 AlN 13 | 12 | 9 | 抵抗値大 |
| ＊12 | WC 100 AlN 0 | 18 | 1 | 亀裂発生 |
| 13 | WC 99 AlN 1 | 18 | 1 | 良好 |
| 14 | WC 95 AlN 5 | 22 | 1 | 良好 |
| 15 | WC 90 AlN 10 | 18 | 3 | 良好 |
| ＊16 | WC 87 AlN 13 | 18 | 9 | 抵抗値大 |
| ＊17 | TiN 100 AlN 0 | 20 | 1 | 亀裂発生 |
| 18 | TiN 99 AlN 1 | 20 | 1 | 良好 |
| 19 | TiN 95 AlN 5 | 24 | 1 | 良好 |
| 20 | TiN 90 AlN 10 | 20 | 3 | 良好 |
| ＊21 | TiN 87 AlN 13 | 20 | 9 | 抵抗値大 |

＊は本発明の範囲外である。

【００２８】次に、本発明の他の実施例を説明する。

【００２９】図２に示す静電チャック２０は、窒化アルミニウム質焼結体製の基体２１中に静電吸着用電極２２とプラズマ発生用電極２３を埋設し、各電極に通電するためのリード線（不図示）を備えたものである。

【００３０】そして、上記静電吸着用電極２２と半導体ウェハ３０間に電圧２５を印加すれば、基体２１の表面に静電吸着力が生じて半導体ウェハ３０を吸着することができる。なお、図では単極型を示したが、基体２１中に複数の静電吸着用電極２２を埋設して、各電極間に電圧を印加するようにした双極型とすることもできる。また、プラズマ発生用電極２３と上部電極２４間に高周波電圧２６を印加することによって両電極間にプラズマを発生させ、半導体ウェハ３０のエッチングやＣＶＤ処理等を行うことができる。

【００３１】上記基体２１を成す窒化アルミニウム質焼結体は前記実施例と同様の高純度のもの、または焼結助剤を含むものを用いる。また、静電チャック２０の製造方法についても前記実施例と同様である。

【００３２】さらに、静電吸着用電極２２は、Ｗ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種を５０～９９重量%とＡｌＮを１～５０重量%との混合体からなるものを用いる。ここで組成比を上記範囲としたのは、ＡｌＮが１重量%未満か又はＷ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種が９９重量%を超えると基体との密着性が悪くなり、一方ＡｌＮが５０重量%を超えるか又はＷ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種が５０重量%未満であると抵抗値が高くなりすぎて不適

当であるためである。このように静電吸着用電極２２の場合は電流が流れないため、前記実施例の発熱抵抗体の場合に比べて抵抗値を大きくすることが可能であり、ＡｌＮの含有量を多くすることができる。

【００３３】また、プラズマ発生用電極２３は、Ｗ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種を８０～９９重量％とＡｌＮを１～２０重量％との混合体からなるものを用いる。ここで組成比を上記範囲としたのは、ＡｌＮが１重量％未満か又はＷ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種が９９重量％を超えると基体との密着性が悪くなり、一方ＡｌＮが２０重量％を超えるか又はＷ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種が８０重量％未満であると抵抗値が高くなりすぎて不適当であるためである。好ましくはＷ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種を９０～９９重量％とＡｌＮを１～１０重量％の範囲が良い。

【００３４】なお、上記プラズマ発生用電極２３は吸着する半導体ウェハ３０よりも広い範囲に形成しておくことが好ましい。これは、半導体ウェハ３０の全面にわたってプラズマを発生させ、半導体ウェハ３０の全面を加工して効率良くチップを取るためである。この場合、基体２１の一部もプラズマに曝されることになるが、前述したような耐食性の高い窒化アルミニウム質焼結体で形成してあるためプラズマによりエッチングされてしまう恐れはない。

【００３５】これらの静電吸着用電極２２とプラズマ発生用電極２３はＡｌＮを含んでいるため、基体２１との密着性が高く、長期使用時にも亀裂等が生じる恐れを防止できる。

【００３６】また、上記実施例では静電吸着用電極２２とプラズマ発生用電極２３を別々に形成した例を示したが、一つの電極で両者を兼ねることもできる。この場合は、プラズマ発生用電極２３の場合と同じ組成範囲とすれば良い。

【００３７】さらに、図示していないが、静電チャック２０の基体２１中に発熱抵抗体を埋設して加熱できるようにすることもできる。

【００３８】以上の実施例では半導体ウェハ３０の保持装置についてのみ述べたが、この他に液晶用ガラス基板等の各種ウェハの保持装置として本発明を適用できることは言うまでもない。

【００３９】

【発明の効果】このように本発明によれば、窒化アルミニウム質焼結体から成る基体中に、Ｗ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種を９０～９９重量％と、ＡｌＮを１～１０重量％からなる混合体を発熱抵抗体として埋設してウェハ保持装置を構成したことによって、基体と発熱抵抗体との密着性を高くして、急速昇温時にも基体の亀裂や発熱抵抗体の剥離、断線等が生じることを防止できる。そのため、６００℃まで１０分で急速昇温することが可能である高性能のウェハ保持装置を提供できる。

【００４０】また、本発明によれば、窒化アルミニウム質焼結体から成る基体中に、Ｗ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種を５０～９５重量％と、ＡｌＮを５～５０重量％からなる混合体を静電吸着用電極として埋設してウェハ保持装置を構成したことによって、基体と静電吸着用電極との密着性を高くし、使用時の基体の亀裂や静電吸着用電極の剥離等を防止して長期間好適に使用することができる。

【００４１】さらに、本発明によれば、窒化アルミニウム質焼結体から成る基体中に、Ｗ，Ｍｏ，ＷＣ，ＴｉＣ，ＴｉＮの少なくとも一種を８０～９５重量％と、ＡｌＮを５～２０重量％からなる混合体をプラズマ発生用電極として埋設してウェハ保持装置を構成したことによって、基体とプラズマ発生用電極との密着性を高くし、使用時の基体の亀裂やプラズマ発生用電極の剥離等を防止して長期間好適に使用することができる。

【図面の簡単な説明】

【図１】（Ａ）（Ｂ）は本発明のウェハ保持装置の一実施例であるサセプタを示す断面図である。

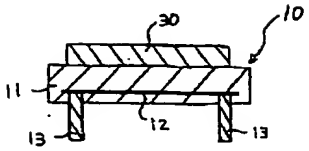
【図２】本発明のウェハ保持装置の一実施例である静電チャックを示す断面図である。

【符号の説明】

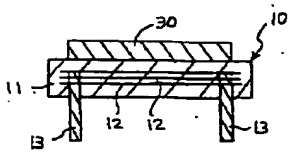
１０：サセプタ
１１：基体
１２：発熱抵抗体
１３：リード線
２０：静電チャック
２１：基体
２２：静電吸着用電極
２３：プラズマ発生用電極
２４：上部電極
３０：半導体ウェハ

【図1】

(A)




(B)




【図2】